(and strongest for executed movements), yet the topographies of neuronal activity did not differ between the three conditions. The strong modulation of oscillatory activity due to quasi-movements allowed to improve the classification of brain states by ~47% compared to motor imagery. Quasi-movements represent a novel, effective strategy for BCI research, and furthermore have implications for studying motor intention, sense of movement, and motor imagery.

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Parieto-occipital alpha power indexes distraction during simulated car driving

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The two major causes of fatal car accidents are distraction of visual attention and lapses in vigilance. Psychophysiological research on real-time classification of driver status aims at reliably identifying cognitive state changes that potentially lead to impaired driving capability. While various vigilance monitors have been suggested, tracking attention non-invasively and with high temporal resolution is still an open challenge. Traditionally, modulation of the parieto-occipital alpha band has been taken as an index of vigilance fluctuations. Recently, parieto-occipital alpha power was found to positively correlate with increasing task demand, which might reflect functional inhibition of irrelevant brain areas during cognitive processing. Here, we characterize EEG signatures indicating competition for attentional resources arising when a primary visual driving task is challenged by a secondary auditory task.

Based on 128-channel EEG recordings different driving conditions were compared during four hours of simulated driving in 11 subjects: *baseline* (fixation cross; no visual flow, no driving), *passive driving* (the co-driver's perspective on visual flow), and *active driving* in a lane change test (LCT). The secondary task was kept constant across conditions: Subjects had to press buttons attached to the left or right thumbs reacting to high and low frequency auditory tones presented in an oddball paradigm every 5 to 6 s.

Reaction times (RT) to auditory stimuli significantly increased from baseline over passive driving to LCT. EEG data showed a stepwise decrease of alpha power from baseline via passive to active driving. In-depth analysis revealed an interaction of alpha power, RT and driving task: increased alpha power preceded faster RT which was significant only during LCT.

Increasing driving task demands are reflected in longer RTs to the secondary task. Classical alpha suppression by visual flow is enhanced by attentive driving. We suggest that for competing tasks, fast reactions to auditory stimuli can be performed only on the expense of a less efficient engagement of visual processing as revealed by a diminished alpha suppression during the LCT. Even if stimulated by visual flow typical for a driving environment, the alpha rhythm is more than a simple indicator of visual stimulation or vigilance fluctuation: the level of its suppression reflects the relative distribution of attentional resources between concurrent visual and non-visual stimuli. We assume that the visual resources required for driving a car may significantly be narrowed when performing a secondary non-visual task which may be detected by EEG.

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A novel mechanism for evoked responses in the human brain

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Magneto- and electroencephalographic (MEG/EEG) evoked responses (ERs) are primary real-time objective measures of cognitive and perceptual processes in the human brain, yet little is known about the neuronal dynamics constituting ERs. Two mechanisms (additive activity and phase reset) have been debated and considered as the only possible explanations for ERs. Here we introduce a novel mechanism for the generation of ERs, which can be deduced entirely from the properties of the ongoing neuronal oscillations, e.g., alpha oscillations. We show that ongoing alpha oscillations are associated with DC-like shifts, which change proportionally to the amplitude of alpha oscillations. We call this phenomenon baseline shifts associated with alpha oscillations. Since alpha oscillations are practically always modulated by sensory stimuli in a time-locked manner, baseline shifts are changing accordingly and unavoidably should lead to the appearance of ERs in MEG/EEG. This is most likely the explanation for the fact that often ERs and amplitude dynamics of alpha oscillations have similar time courses and spatial distributions. Moreover, the presence of baseline shifts associated with alpha oscillations allows a striking prediction of the polarity of ERs on the basis of amplitude dynamics of alpha oscillations at rest condition. We provide an analytic description of the novel mechanism for ERs and using modeling experiments show that although there might exist a unique relationship between the amplitude of neuronal oscillations and DC-like baseline shifts, this relationship can be obscured on a sensor level due to spatial superposition of non-synchronous oscillatory sources. We show also a theoretical possibility for obtaining ERs in single trials on the basis of baseline shifts.

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Anticipatory activity in the human thalamus is predictive of reaction times

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Responding to environmental stimuli in a fast manner is a fundamental behavioral capacity. The pace at which one responds is known to be predetermined by cortical areas, but it remains to be shown if subcortical structures also take part in defining motor swiftness. As the thalamus has previously been implicated in different aspects of behavioral control, we tested if neuronal activity at this level could also predict the reaction time of upcoming movements. To this end we simultaneously recorded EEG from the scalp and the ventral intermediate nucleus (VIM) of the thalamus in patients undergoing thalamic Deep Brain Stimulation. Patients performed a Go/NoGo task and the latter part of a contingent negative variation (1500 ms after a warning stimulus and 500 ms before the Go/NoGo-stimulus) in both VIM and cortex was used for the prediction of the subsequent reaction times. Using single-trials analysis we showed that in five out of seven patients the degree of activation, preceding imperative stimuli, correlated with the subsequent reaction times in both scalp and contra-/ipsilateral thalamic recordings. Moreover, the present results indicate that although thalamic and cortical activities were correlated with reaction time, they were not correlated with each other in the majority of cases. This could be due to the fact that the recorded cortical and thalamic activities reflect different aspects of anticipatory processing related to distinct brain circuitries. Two conceptual consequences follow from the present results. First, anticipatory states determine behavioral performance at cortical as well as at subcortical levels, the latter not being a rigid downstream machinery for motor processing. Second, reaction time appears to result from the cooperative preparedness in cortical and subcortical motor structures.

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